

This Page Is Inserted by IFW Operations  
and is not a part of the Official Record

## **BEST AVAILABLE IMAGES**

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

**IMAGES ARE BEST AVAILABLE COPY.**

**As rescanning documents *will not* correct images,  
please do not report the images to the  
Image Problem Mailbox.**

PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION  
International Bureau



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification<sup>4</sup>:

C03C 13/06

(11) International Publication Number:

WO 90/02713

A1

(43) International Publication Date:

22 March 1990 (22.03.90)

(21) International Application Number: PCT DK89 00205

(22) International Filing Date: 4 September 1989 (04.09.89)

(30) Priority data:  
4923 88 5 September 1988 (05.09.88) DK

(71) Applicant (for all designated States except US): ROCKWOOL  
INTERNATIONAL A/S [DK DK]: Hovedgaden 501,  
DK-2640 Hedehusene (DK).

(72) Inventor: and

(75) Inventor/Applicant (for US only): MOGENSEN, Gurli  
[DK DK]: Egevej 78, Vemmedrup, DK-4632 Bjæverskov  
(DK).

(74) Agent: LEHMANN & REE: Frederiksberg Allé 26, DK-  
1820 Frederiksberg C (DK).

(81) Designated States: AT (European patent), BE (European patent), CH (European patent), DE (European patent), FI, FR (European patent), GB (European patent), IT (European patent), LU (European patent), NL (European patent), NO, SE (European patent), US.

Published

With international search report.

(54) Title: MINERAL FIBRES

(57) Abstract

Fibres with the following composition: SiO<sub>2</sub> 47-54% by weight, Al<sub>2</sub>O<sub>3</sub> 4-7.5% by weight, Fe<sub>2</sub>O<sub>3</sub> 1-8.5% by weight, CaO 10-24.5% by weight, MgO 10-21% by weight, Na<sub>2</sub>O 0.1-10% by weight, K<sub>2</sub>O 0.1-1.5% by weight soluble in salt solutions.

*FOR THE PURPOSES OF INFORMATION ONLY*

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	ES	Spain	MG	Madagascar
AU	Australia	FI	Finland	ML	Mali
BB	Barbados	FR	France	MR	Mauritania
BE	Belgium	GA	Gabon	MW	Malawi
BF	Burkina Faso	GB	United Kingdom	NL	Netherlands
BG	Bulgaria	HU	Hungary	NO	Norway
BJ	Benin	IT	Italy	RO	Romania
BR	Brazil	JP	Japan	SD	Sudan
CA	Canada	KP	Democratic People's Republic of Korea	SE	Sweden
CF	Central African Republic	KR	Republic of Korea	SN	Senegal
CG	Congo	LJ	Liechtenstein	SU	Soviet Union
CH	Switzerland	LK	Sri Lanka	TD	Chad
CM	Cameroon	LJ	Luxembourg	TG	Togo
DE	Germany, Federal Republic of	MC	Monaco	US	United States of America
DK	Denmark				

Mineral fibres

The present invention relates to a novel type of mineral fibres.

- 5 Conventional mineral fibres are produced from naturally occurring materials and therefore the costs of raw materials are relatively low.

Such known mineral fibres typically have the following composition:

10

	SiO <sub>2</sub>	about 45	% by weight
	Al <sub>2</sub> O <sub>3</sub>	- 13.5	-
	FeO	- 5.5	-
	CaO	- 20.5	-
15	MgO	- 10.5	-
	TiO	- 1.0	-
	Na <sub>2</sub> O + K <sub>2</sub> O	- 2.5	-

- 20 The known mineral fibres are characterized by their high temperature resistance, but they are only slightly affected by salt solutions. Therefore they degrade very slowly when deposited at a tip or in other places in nature after use.

- 25 The specification of NO patent application No. 874323 (Manville Corporation) describes inorganic fibres serving as a substitute for conventional mineral wool fibres and containing MgO in an amount of 0.1-30 % by weight and Al<sub>2</sub>O<sub>3</sub> in an amount of 0-10 % by weight in addition to SiO<sub>2</sub> and CaO. According to the above-mentioned patent application said fibres, which are mainly characterized in having a
- 30 relatively low content of Al<sub>2</sub>O<sub>3</sub>, are considerably more soluble in salt solutions than conventional mineral fibres, e.g. in the so-called Gamble's solution, i.e. an aqueous solution containing the following salts in a dissolved form:

35	<u>Component</u>	<u>Concentration g/l</u>
	MgCl <sub>2</sub> · 6H <sub>2</sub> O	0.160
	NaCl	6.171
	KCl	0.311

2

	$\text{Na}_2\text{HPO}_4$	0.149
	$\text{Na}_2\text{SO}_4$	0.079
	$\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$	0.060
	$\text{NaHCO}_3$	1.942
5	$\text{NaC}_2\text{H}_3\text{O}_2$	1.066

An essential drawback of the known soluble fibres is that they are produced from relatively expensive oxides and not from naturally occurring raw materials.

10

Furthermore some of the known fibres have a relatively poor heat resistance and are consequently unsuitable for use at high temperatures.

15

Surprisingly it has been found that mineral fibres with a considerably greater solubility in salt solutions than the above-mentioned known mineral fibres, and which at the same time exhibit an acceptable high temperature resistance can be produced from naturally occurring raw materials and other inexpensive raw materials.

20

Mineral fibres according to the invention are characterized in having the following composition:

	$\text{SiO}_2$	47-54	% by weight
25	$\text{Al}_2\text{O}_3$	4-7.5	-
	$\text{Fe}_2\text{O}_3$	1-8.5	-
	$\text{CaO}$	10-24.5	-
	$\text{MgO}$	10-21	-
	$\text{Na}_2\text{O}$	0.1-10	-
30	$\text{K}_2\text{O}$	0.1-1.5	-

the total content of  $\text{SiO}_2$ ,  $\text{Al}_2\text{O}_3$  and  $\text{Fe}_2\text{O}_3$  not exceeding 65 % by weight.

35

Mineral fibres of the above-mentioned composition can be produced from naturally occurring raw materials and other readily obtainable and inexpensive materials such as waste products from the production of mineral wool fibres and glass. Examples of such raw material compositions are listed in Table I.

Table IRaw material composition

5	1	Diabase	70 %
		Cement briquettes <sup>1)</sup>	30 %
	2	Diabase	20 %
		Clay briquettes <sup>2)</sup>	80 %
10	3	Cement briquettes <sup>3)</sup>	80 %
		Olivine-containing diabase	20 %
15	4	Clay briquettes consisting of:	
		Clay	45 %
		Sand	22 %
		Olivine sand	22 %
		Rasorite (Sodium borate)	8 %
		Blast-furnace slag	8 %
20		Iron oxide	3 %
		Clay briquettes consisting of:	
25	5	Clay	50 %
		Rock wool waste	10 %
		Lime	20 %
		Sand	10 %
		Olivine sand	10 %
		Clay briquettes consisting of:	
30	6	Clay	50 %
		Lime	20 %
		Sand	10 %
		Olivine sand	10 %
		Soda	10 %
		Cement briquettes consisting of:	
35	7	Olivine	53 %
		Glass waste from the production of glass bottles	35 %

Cement

12 %

- 1) Consisting of 12 % cement, 40 % mineral wool waste, 5 % dolomite and 43 % diabase.
- 2) Consisting of 50 % clay, 30 % mineral wool waste, 15 % olivine sand and 5 % iron oxide slag.
- 3) Consisting of 15 % cement, 23 % mineral wool waste, 22 % sand, 10 % olivine sand, 30 % olivine-containing diabase.

The solubility of the mineral fibres of the invention and known fibres has been examined by storing fibre samples weighing 830 mg in 250 ml of said Gamble's solution for 5 hours at a temperature which was increased from 37°C to 60°C and by measuring the SiO<sub>2</sub>-concentration of the solution at the end of the test.

The results obtained will appear from Table II.

Table II

	Compo- sition	<u>Known Mineral Fibres</u>		<u>Mineral fibres according to the in- vention</u>			
		<u>Test 1</u>	<u>Test 2</u>	<u>Test 3</u>	<u>Test 4</u>	<u>Test 5</u>	<u>Test 6</u>
	SiO <sub>2</sub>	44.6	49.0	50.5	54.2	50.8	47.2
	Al <sub>2</sub> O <sub>3</sub>	13.3	10.3	5.8	5.9	6.2	6.9
	TiO <sub>2</sub>	1.1	2.2	0.6	0.4	0.4	0.4
	Fe <sub>2</sub> O <sub>3</sub>	6.1	8.0	7.9	5.0	2.3	3.0
	CaO	20.3	14.3	11.8	9.8	24.4	20.7
	MgO	10.6	11.8	20.0	17.0	12.7	14.4
	Na <sub>2</sub> O	2.0	1.7	0.2	2.2	0.5	6.5
		0.5	1.6	0.5	1.1	1.3	0.7
	B <sub>2</sub> O <sub>3</sub>				3.2		

	Solubi-						
	lity,						
	ppm						
5	SiO <sub>2</sub>	3.74	1.84	8.22	4.79	12.88	10.80

As will appear from the above Table II the mineral fibres according to the invention have a considerably higher solubility in the salt solution than the conventional known fibres.

10

A fibre sample according to NO patent application No. 874323 was subject to a similar examination. The fibres had the following composition:

15	SiO <sub>2</sub>	50.2 % by weight
	Al <sub>2</sub> O <sub>3</sub>	10.0 -
	TiO <sub>2</sub>	0.3 -
	Fe <sub>2</sub> O <sub>3</sub>	0.7 -
	CaO	27.9 -
20	MgO	6.8 -
	Na <sub>2</sub> O	0.2 -
	K <sub>2</sub> O	0.7 -

A solubility corresponding to a SiO<sub>2</sub>-concentration of 3.16 ppm was measured which is also considerably less than the solubility of the fibres of the invention.

It could be feared that mineral fibres with a relatively high solubility in salt solutions would be sensitive to heat and therefore would be unsuitable for use at high temperatures and that they lack the necessary fire resistance. However, tests have shown that this fear is groundless in respect of the fibres according to the invention.

The tests were carried out with mineral fiber samples weighing from 0.5 to 1 g. These samples were placed on a refractory plate and then inserted into an oven which was preheated to a given temperature. After 30 minutes in the oven at this given temperature the fibre samples were removed from the oven and examined. If the dimensions,



structures and elasticity of the fibres were unchanged this was taken as an indication of the fibres being resistant at the given temperature.

- 5 If it was found that the fibres were brittle (sintered), a new sample was subject to a similar treatment at a temperature which was 25°C below the one tried first.

- 10 If necessary the test was repeated with a further reduction of the temperature until the fibres remained unchanged.

- 15 The examination of the mineral fibres according to the invention (tests 3-6) listed in Table II showed that they were all resistant at a temperature higher than 750°C which corresponds to the temperature resistance of the mineral fibre sample according to NO patent application No. 874323.

Mineral fibres according to the invention with a composition within the following limits:

20

SiO <sub>2</sub>	47-51	% by weight
Al <sub>2</sub> O <sub>3</sub>	5-7	-
Fe <sub>2</sub> O <sub>3</sub>	2-4	-
CaO	15-21	-
25 MgO	10-15	-
Na <sub>2</sub> O	0.5-7	-
K <sub>2</sub> O	0.5-1.5	-

- 30 exhibit a particularly high solubility in salt solutions.

Patent claims

1. Mineral fibres, characterized in having the following composition:

5		47-54	% by weight
	SiO <sub>2</sub>	4-7.5	-
	Al <sub>2</sub> O <sub>3</sub>	1-8.5	-
	Fe <sub>2</sub> O <sub>3</sub>	10-24.5	-
	CaO	10-21	-
10	MgO	0.1-10	-
	Na <sub>2</sub> O	0.1-1.5	-
	K <sub>2</sub> O		

2. Mineral fibres according to claim 1, characterized in having the following composition:

		47-51	% by weight
	SiO <sub>2</sub>	5-7	-
	Al <sub>2</sub> O <sub>3</sub>	2-4	-
	Fe <sub>2</sub> O <sub>3</sub>	15-21	-
20	CaO	10-15	-
	MgO	0.5-7	-
	Na <sub>2</sub> O	0.5-1.5	-
	K <sub>2</sub> O		

25

30

35

# INTERNATIONAL SEARCH REPORT

International Application No

PCT/DK89/00205

**I. CLASSIFICATION OF SUBJECT MATTER** (A general classification symbol is indicated on the first page of the application.)

According to International Patent Classification (IPC) or to both National Classification and IPC:

C 03 C 13/06

**II. FIELDS SEARCHED**

Minimum Documentation Searched:

Classification System

Classification Symbols

IPC 4

C 03 C

US C1

106

Documentation Searched other than Minimum Documentation to the extent that such Documents are included in the Fields Searched:

SE, NO, DK, FI classes as above

**III. DOCUMENTS CONSIDERED TO BE RELEVANT\***

Category: Citation of Document, with indication, where appropriate, of the relevant passages: Relevant to Claim No. 13

- |   |         |                                                                                              |
|---|---------|----------------------------------------------------------------------------------------------|
| A | US, A,  | 2 576 312 (LEONARD JOHN MINNICK)<br>27. November 1951                                        |
| A | GB, A,  | 2 152 026 (INSTITUT FÜR MINERALISCHE<br>ROHSTOFF-UND LAGERSTATTENWIRTSCHAFT)<br>31 July 1985 |
| A | DE, A1, | 3 222 546 (MENGEL, KURT, DR)<br>5 May 1983                                                   |

\* Special categories of cited documents: 10

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"A" document member of the same patent family

## IV. CERTIFICATION

Date of the Actual Completion of the International Search

1989-11-15

International Searching Authority

Swedish Patent Office

Date of Mailing of this International Search Report

1989-12-04

Signature of Authorized Officer

Mav Hallne